Objective

To manually tune the 590 drive.

Note. The default values for the field and speed loops will typically be stable; however, some motors and loads require manual tuning.

Equipment

590 DC drive (> v4.2), Oscilloscope.

Current Loop for Large Motors

The autotune procedure may not produce satisfactory results with large motors with long armature time constants. The first stage of the autotune measures the point at which the current becomes continuous. Continuous current is when the current pulses join and the current does not get to zero between pulses.

With large armature time constants, this may occur at less than 10% of full load current so the measurement may be less accurate. The adaptive current control compensates for the inherent reduction in gain when the current is discontinuous by using a predictive algorithm.

If the measured discontinuous value is too high, the higher gain may cause instability when the current goes continuous. Reducing the discontinuous value below the actual value can increase stability (at the expense of slower response).

Note. The discontinuous value should not be set above the actual value.

When to manually tune?

?? When the discontinuous autotune value is less than 10%.

?? When the motor rating is over 500HP.

?? When the motor rating is greater than 200HP with greater than 2:1 field range.

?? When the motor is old.

Procedure

Current Loop Tuning

Warning! The internal test oscillator bypasses the current limit and speed loop. The motor may rotate due to residual or series fields. High currents should only be applied for short periods to a stationary motor.

1. Change PASSWORD to the superuser password 1311. When you are finished with this procedure the password should be set back to its original value (0x0000 is default).
2. Disable the field, with a series field the motor shaft may have to be locked.
3. Monitor the armature current waveform on the test pin with an oscilloscope.
4. Enable the test oscillator in the RESERVED menu by setting SEL. INT/CUR/SPD to 0.
   Note: TOGGLE REF 1 and TOGGLE REF 2 are the current demands, and TOGGLE PERIOD sets the oscillator period (default 160*2.7mS at 60Hz).
5. Set TOGGLE REF 1 to 5% and TOGGLE REF 2 to 0%.
6. Start the drive and adjust TOGGLE REF 1 until the current is just continuous.

If you have questions, please call the Product Support Group at (704) 588-3246.

7. Enter the current value from step 5 as the discontinuous value in "CURRENT LOOP".
   Note: Large motors with a low continuous current value, set the discontinuous value in the Current loop to less than the actual value for safety; for example, 80%.

8. Set TOGGLE REF 1 to 5% above the discontinuous value and TOGGLE REF 2 to 20% above TOGGLE REF 1.
9. Start the drive and adjust the Current Loop Proportional and Integral gains to optimize the response. Increase the I gain to give a fast rise with not more than 10% overshoot, then increase the P gain to produce critical damping (practically no overshoot).
   Note: If the I gain is too high, the response will be underdamped (excessive overshoot with long oscillatory settling). If the I gain is too low, the response will be overdamped (long exponential rise). With the I gain optimally set, if the P gain is too low the response will be underdamped. If the P gain is too high, the response will become underdamped with a tendency to instability.
10. Check the current loop response at higher currents, in the reverse direction and from one direction to the other (regenerative drives only).
11. Set the SEL. INT/CUR/SPD back to 2 and SAVE PARAMETERS.
    Note: Some large motors are very unstable in speed control at low load due to the adaptation in discontinuous current. Reducing the adaptive gain by changing the Disc Adapt Pot and the HF C/O Disc Gain in the Reserved Menu can improve the stability. Reduce both parameters to the same value; for example, to 1000. Recheck the current loop performance in the discontinuous region.

Field Control Tuning

The Field control has two control loops, the field current loop and the back emf loop for field weakening.

Note. The 590L V4 surface mount board has a hardware problem causing the field current feedback to be unstable which degrades the field control performance. This can be rectified, if necessary, by adding a 150pF capacitor across R37.

1. Monitor the field current with an oscilloscope. TP4 on the 590D (rectified) or on the Cal Board connector pin J (unrectified).
2. Step the field current by switching from "Quench" to "Standby" (0 to 50%) or "Start" from Standby (50 to 100%).
3. Adjust the Field Prop Gain and Int. Gain for rise time and overshoot (similar to the Current Loop above).
4. Save Parameters.

Field Weakening Loop

5. Check the field current loop response before tuning the field-weakening loop.
6. Monitor Armature Volts with an oscilloscope on TP3 on the 590D or on the Cal Board connector pin I.
7. Start the drive and increase the speed into the field-weakening region.

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8. If the Armature volts are unstable, decrease the EMF Gain or increase the EMF lead and lag. Preferably the EMF gain should not be reduced below 0.20, as this will affect the steady state voltage.
9. The EMF lag and lead should be maintained in the ratio of 20:1. With larger motors they should be increased together as required (maximum lead 10, lag 200).

10. Apply small step speed changes, 5-10%, and check stability of the armature volts. Adjust the EMF gain and EMF lead and lag as above to achieve optimum response.
11. BEMF Lead and Lag are provided to limit armature voltage overshoot where the acceleration rate exceeds the rate at which the field can be reduced due to the long field time constant. BEMF gain is the ratio of Lead/Lag and at 1 has no effect.
12. Accelerate the motor at the specified rate through the field range. If the voltage overshoot is excessive, increase both the BEMF Lead and Lag, with the ratio of lead/lag = 2, until the overshoot is acceptable. The ratio can be varied but too much (above about 2.5) will cause instability. Increasing the Lead and Lag together increases the time constant.

Below are sample parameters for a large motor with field range.

Prop Gain	0.3
Int. Gain	0.4
EMF Gain	0.25
EMF Lead	10
EMF Lag	200
BEMF Lead	2000
BEMF Lag	1000

When you have completed this procedure be sure to reset the password

back to its original value (0x0000 is default) and do a parameter save.

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